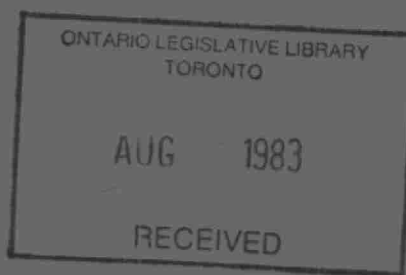


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AIR QUALITY KENORA

ANNUAL REPORT, 1976



Ontario

Ministry
of the
Environment

L. F. Pitura
Director
Northwestern Region

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AIR QUALITY
KENORA

ANNUAL REPORT, 1976

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TECHNICAL SUPPORT SECTION
NORTHWESTERN REGION
ONTARIO MINISTRY OF THE ENVIRONMENT

April, 1977

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SUMMARY

This report presents results of air quality assessment investigations undertaken by Ontario Ministry of the Environment in Kenora in 1976. These studies included vegetation assessment, snow sampling and air monitoring programmes in the vicinity of a local sulphite pulp mill.

No vegetation injury attributable to the presence of air pollutants was noted in 1976. This represents an improvement over the situation in 1974 and 1975, when sulphur dioxide injury symptoms were observed on foliage of vegetation south of the mill.

Snow samples collected in February, 1976, when the mill was not operating, showed that levels of calcium, magnesium and sulphate had sharply decreased to concentrations normally expected in snow remote from industrial contamination. Bark char particles, evident in snow from earlier surveys, were also absent in early 1976. The adverse environmental effects of the presence of these contaminant substances is not presently known.

Dustfall was generally within the Ontario criterion, except at one site northeast of the mill. Bark char emitted by the mill was an identifiable component of dustfall at this location. The concentration of soluble sulphate in dustfall was very low. Dustfall levels were lowest during months when the mill was closed. Most suspended particulate levels were well below the provincial criterion and the mill was not implicated as a source of suspended particulate emissions.

Lowest sulphation rates were also encountered during strike months. Sulphation rates during the remainder of the year were below the Ontario criterion, although the annual average had increased at one location in comparison with 1973-1975 period.

INTRODUCTION

Air quality assessment programmes in the town of Kenora began in 1970. Historical details of these studies, conducted by Ontario Ministry of the Environment, were summarized in an earlier report (1). Most of this work, comprising vegetation assessment, snow sampling and air monitoring, was continued in 1976.

Surveys were concentrated in the vicinity of the principal industrial air pollution source in Kenora - a 260 ton-per-day sodium-base sulphite pulp mill. Sulphur dioxide and particulate matter were the potential airborne contaminants of greatest concern near this operation. To assess the effects, if any, of a termination of mill operation on the local environment, snow sampling in 1976 coincided with a period when the mill was closed by a labour strike.

VEGETATION ASSESSMENT

Complaints of air pollution from residents living near the sulphite mill have been received by the Ministry from time to time for several years. Some of these complaints have concerned alleged air pollution injury to vegetation. In recent years, the worst incident of confirmed air pollution damage to local vegetation was documented in July, 1974, when sulphur dioxide injury symptoms were observed on a range of plant species in several residential gardens. In 1975, injury caused by the same pollutant was confined to a much smaller area close to the mill.

Vegetation assessment surveys were conducted in late June, mid-July and mid-August, 1976. The first survey was carried out in conjunction with an investigation of a complaint of air pollution damage to vegetable crops in a residential garden. This investigation revealed that the vegetables were damaged by fungus diseases and insects and were free of air pollution injury symptoms. Other vegetation near the mill was found to be normal. Similarly, the July and August surveys showed no evidence of air pollution damage on any vegetation in the vicinity of the sulphite mill.

SNOW SAMPLING

(a) Methods

One set of snow samples from 19 sites in the vicinity of the sulphite mill and the adjacent town area was collected on February 26, 1976. Control samples were obtained from two locations judged to be remote from air pollution effects.

Sample points were selected in undisturbed snow, with preference for areas sufficiently open to permit the free fall of snow but not subject to excessive drifting. Areas close to roads or other local sources of contamination were avoided. Each site was mapped, and information on site description, snow condition and snow depth was recorded. The nature and quantity of visible particulate contamination on and below the snow surface was also noted. Each sample comprised a surface area of about 50 by 50 centimetres (cm) and a depth of about 20 cm. Snow was collected with a clean plastic shovel and placed in large, heavy-gauge plastic bags and retained in unmelted condition pending further processing. Samples were melted indoors in clean plastic pails pre-rinsed with distilled water. Measurements of pH were made as soon as melting was completed (about 12 to 18 hours). Meltwater was then vigorously stirred to suspend the particulate matter and decanted into clean, 1-litre plastic bottles for submission to the laboratory.

Kenora snow samples were analysed for calcium, total carbon, magnesium and sulphate content.

(b) Results

Sampling surveys conducted in 1974 and 1975 demonstrated the presence of moderately elevated levels of calcium and sulphate and slightly elevated concentrations of magnesium in snow in the vicinity of the sulphite mill (2,3). Both calcium and sulphate showed pronounced gradients of decreasing concentration with increasing distance from the mill, thereby implicating the latter as the source of contamination. Elevated pH values were also noted near the mill,

possibly in response to the presence of calcium in the snow. Calcium contamination was tentatively ascribed to the deposition of lignite coal ash discharged from the mill's power boiler stack. Black particulate matter, identified as bark char, was observed on and below the snow surface up to 2000 m from the mill.

The 1976 survey was conducted during a period when the mill had been closed for about four months. Chemical analysis results are shown in Table 1, which also gives values at the same sites for the preceding year. The data for total carbon was not included, since no comparable 1975 results were available. The contents of Table 1 clearly show that the 1976 levels of calcium, magnesium and sulphate were very low both near and remote from the mill, and much lower than the concentrations found in 1975 when the mill was operating normally. These findings support earlier conclusions that the presence of these contaminants in 1974 and 1975 was due to emissions from the mill. As expected, there was no evidence of unusual visible particulate contamination in any of the 1976 samples.

(c) Discussion

Snow sampling surveys are designed to reveal the nature, level and extent of contaminants in snow. Although elevated quantities of calcium, magnesium and sulphate have been found in Kenora snow, the adverse environmental effects, if any, of the presence of these substances has not yet been established.

Based on investigations in several locations in northern Ontario, guidelines have been developed for concentrations of a number of contaminants in snow meltwater. Levels above 5 milligrams per litre (mg/l) for calcium and 10 mg/l for sulphate are considered excessive. At Kenora, values above these guidelines have been recorded within 500 m of the sulphite mill.

AIR MONITORING

(a) Dustfall

Dustfall is one of the most visible classes of air pollutants, and comprises particulate matter which settles out from the atmosphere under the influence of gravity. It is measured by exposing open-top vessels for 30 days and weighing the collected matter. Results are expressed in tons per square mile per month. The soluble fraction of dustfall may also be analysed for sulphate and other constituents, with results expressed in the same units used for total dustfall.

Monitoring sites in Kenora for dustfall are shown in Figure 1, and the values for total dustfall and soluble sulphate in dustfall are given in Table 2. The Ontario criterion for monthly dustfall (20 tons per square mile) was exceeded at least once at each of the four stations. Above criterion levels were most frequent at station 61007, northeast of the mill, and this was the only site where the criterion for annual average dustfall (13 tons per square mile) was also exceeded. Lowest values were recorded in January and February when the mill was closed. Soluble sulphate levels were very low. Annual averages for total dustfall in 1976 are plotted in Figure 2, and averages for 1974, 1975 and 1976 are compared in Table 3. The trend during the past three years has been one of improvement, though dustfall levels at station 61007 remained unsatisfactorily high. Bark-char particles were the only visible identifiable contaminant in Kenora dustfall jars during the year. The greatest quantity of this substance was encountered at station 61007 in October, November and December.

(b) Suspended Particulate

Suspended particulate constitutes particulate matter of small size which remains in the atmosphere for extended periods. A known volume of air is drawn through pre-weighed glass fibre filters for 24-hour periods and the filters are then re-weighed to determine

the quantity of dust collected. Results are expressed in micrograms per cubic metre of air ($\mu\text{g}/\text{m}^3$).

A list of values for 1976 is presented in Table 4. The provincial criterion ($120 \mu\text{g}/\text{m}^3$) was exceeded on only three of 50 sampling dates. On these occasions, winds were southerly and yellow pollen was observed on two of the three exposed filters. In relation to wind direction, an average value of $27 \mu\text{g}/\text{m}^3$ was associated with northerly prevailing winds, 33 with easterly wind, 57 with south wind and 42 with west wind. Since the lowest average was associated with north winds, the sulphite mill was not implicated as a source of fine particulate emissions. The overall geometric mean was $31 \mu\text{g}/\text{m}^3$ for 1976, well below the Ontario criterion of 60.

(c) Sulphation

Sulphation rate is measured by exposing lead dioxide plates to the air for 30-day periods. Lead dioxide reacts with gaseous sulphur compounds in the atmosphere to form lead sulphate. The amount of sulphate formed is analytically determined and results reported as milligrams of sulphur trioxide per hundred square centimetres per day ($\text{mg SO}_3/100 \text{ cm}^2/\text{day}$). Although several sulphur compounds may react with lead dioxide, sulphur dioxide is considered to be the only reactive pollutant in the centre of Kenora.

Sulphation monitoring sites are shown in Figure 3 and results summarized in Table 5. Lowest values occurred during January and February, when the mill was closed, and the highest levels were recorded in May. The current Ontario monthly criterion, $0.70 \text{ mg SO}_3/100 \text{ cm}^2/\text{day}$, was not exceeded. Contrary to expectation, the two closest stations (61003 and 61007) had sulphation rates not very different from those at the more remote sites (61006 and 61008). At station 61003, the only location for which historical data are available, the average sulphation was 0.17 in 1973, 0.13 in 1974, 0.07 in 1975 and 0.20 in 1976.

ACKNOWLEDGEMENTS

Contributions and assistance from the following agencies is gratefully acknowledged:

- Regional Laboratory, Northwestern Region, for dustfall and suspended particulate weight determinations, for sulphate analysis of dustfall and for chemical analysis of snow meltwater.
- Industrial Abatement Section, Kenora District Office, for operation of the Kenora air monitoring network.
- Air Quality Laboratory Section, Laboratory Services Branch, for preparation and analysis of sulphation plates.
- Organic Trace Contaminants Section, Laboratory Services Branch, for carbon analysis of snow meltwater.

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2. Griffin, H. D. (1974). Snow sampling study, Kenora, 1974. Ontario Ministry of the Environment.
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TABLE 1. Levels of calcium, magnesium, sulphate (all in mg/l) and pH in snow collected in Kenora in 1975 and 1976.

Distance(metres) and direction from source*	Calcium		Magnesium		Sulphate		pH	
	1975	1976	1975	1976	1975	1976	1975	1976
250 N	12	<1	4	<1	9	<1	8.6	4.2
500 N	10	<1	1	<1	6	<1	8.7	3.3
1000 N	8	<1	<1	<1	5	<1	8.3	3.2
350 NE	-	<1	-	<1	-	<1	-	3.1
825 NE	-	<1	-	<1	-	<1	-	3.0
500 E	2	<1	1	<1	2	<1	6.8	3.1
1000 E	2	<1	<1	<1	2	<1	6.2	3.1
400 SE	-	<1	-	<1	-	<1	-	3.6
500 SE	-	<1	-	<1	-	<1	-	3.6
250 S	9	<1	7	<1	20	<1	8.0	3.6
500 S	6	<1	1	<1	4	<1	8.2	3.6
1000 S	3	<1	<1	<1	2	<1	6.7	4.2
400 SW	-	<1	-	<1	-	<1	-	3.6
1175 SW	-	<1	-	<1	-	<1	-	3.7
250 W	6	<1	2	<1	8	<1	7.2	3.5
500 W	2	<1	<1	<1	2	<1	5.5	3.2
1000 W	2	<1	<1	<1	2	<1	5.6	3.2
400 NW	-	<1	-	<1	-	<1	-	3.6
700 NW	-	<1	-	<1	-	<1	-	3.2
5600 W(control)	1	<1	<1	<1	<1	<1	3.7	3.1
9000 ENE(control)	1	<1	<1	<1	1	<1	3.7	3.0

*Source arbitrarily designated as digester relief stack, Ontario-Minnesota Pulp and Paper Company Limited sulphite mill.

TABLE 2. Total dustfall and sulphate in dustfall, Kenora, 1976.

Station	Location	Distance(metres) and direction from source*	Dustfall (tons/square mile/30 days)												Average
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
61003	Fourth/Main	140 S	6	5	9	7	<u>38</u>	<u>25</u>	7	17	10	9	11	7	12
61006	Matheson/Fourth	395 SE	1	5	6	<u>26⁺</u>	<u>7</u>	-	-	-	8	9	12	14	10
61007	Melick/Ninth	225 NE	3	5	13	<u>14</u>	19	<u>27</u>	16	<u>28</u>	<u>35</u>	<u>55</u>	<u>46</u>	<u>33</u>	<u>24</u>
61008	Melick/Eleventh	475 N	-	4	7	9	8	<u>21</u>	7	<u>9</u>	<u>7</u>	<u>9</u>	<u>10</u>	<u>8</u>	<u>9</u>
Soluble sulphate (tons/square mile/30 days)															
61003	Fourth/Main	140 S	-	0.4	0.5	0.8	1.3	1.7	0.2	0.6	0.6	0.4	0.5	0.3	0.7
61006	Matheson/Fourth	395 SE	-	0.2	0.4	1.5	0.5	-	-	-	0.2	0.3	1.3	0.6	0.5
61007	Melick/Ninth	225 NE	-	0.2	0.7	0.7	0.5	1.9	0.6	0.8	0.6	1.8	1.5	0.8	0.9
61008	Melick/Eleventh	475 N	-	0.1	0.2	0.4	0.3	1.7	0.1	0.5	0.3	0.4	0.4	0.7	0.5

TABLE 3. Comparison between annual average dustfall levels (tons/sq. mi./30 days) in 1974, 1975 and 1976.

Station	Location	Distance(metres) and direction from source*	1974	1975	1976
61003	Fourth/Main	140 S	<u>18</u>	<u>16</u>	12
61006	Matheson/Fourth	395 SE	<u>15</u>	<u>12</u>	10
61007	Melick/Ninth	225 NE	<u>41</u>	<u>22</u>	<u>24</u>
61008	Melick/Eleventh	475 N	<u>18</u>	<u>17</u>	<u>9</u>

*Source arbitrarily designated as digester relief stack, Ontario-Minnesota Pulp & Paper Company Limited sulphite mill.

*Values exceeding criteria of 20 (monthly dustfall) or 13 (annual average dustfall) are underlined.

TABLE 4. Suspended particulate levels ($\mu\text{g}/\text{m}^3$) at station 61003, Kenora, 1976.

Date	$\mu\text{g}/\text{m}^3$	Wind*	Date	$\mu\text{g}/\text{m}^3$	Wind*
January 1	5	E 12	July 5	-	
7	16	W 14	11	51	N 15
13	-	WNW 17	17	-	
19	11	N 19	23	50	WNW 18
25	6	N 9	29	52	SSE 12
31	9	N 15			
February 6	12	SSW 13	August 4	-	
12	18	NW 18	10	35	S 12
18	6	N 10	16	51	SE 15
24	73	SSW 9	22	39	NNW 12
			28	12	NW 22
March 1	7	E 18	September 3	43	W 24
7	7	WNW 16	9	82	WNW 13
13	11	S 20	15	29	S 15
19	21	SW 9	21	34	N 10
25	26	E 13	27	34	
31	42	N 6			
April 6	-		October 3	73	SSE 26
12	<u>151</u> **	S 14	9	26	NW 5
18	<u>16</u>	SSW 13	15	41	N 19
24	-		21	14	WNW 18
30	30	NNW 20	27	-	
May 6	64	WNW 14	November 2	103	WNW 28
12	82	SSE 20	8	61	S 19
18	47	SSE 18	14	67	SW 11
24	51	E 10	20	26	NNW 6
30	<u>137</u>	SSW 11	26	34	NW 22
June 5	<u>124</u>	S 22	December 2	25	S 13
11	<u>60</u>	E 21	8	-	
17	-		14	-	
23	-		20	42	NW 15
29	39	NNE 14	26	17	SW 13

*Prevailing wind direction and speed (kilometres per hour).

** Values above criterion of $120\mu\text{g}/\text{m}^3$ are underlined.

TABLE 5. Sulphation rates (mg SO₃/100 cm²/day) in Kenora, 1976.

Station	Location	Distance(metres) and direction from source*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
61003	Fourth/Main	140 S	.06	.10	.38	.19	.44	.24	.22	-	-	.12	.14	.15	.20
61006	Matheson/Fourth	395 SE	.06	.10	.16	.24	.32	.24	.20	.09	.09	-	.10	.24	.17
61007	Melick/Ninth	225 NE	.06	.13	.12	.25	.46	.28	.26	.20	.28	.26	.25	.15	.22
61008	Melick/Eleventh	475 N	.06	.10	.14	.18	.48	.28	.12	.21	-	-	.24	.18	.20

*Source arbitrarily designated as digester relief stack, Ontario-Minnesota Pulp & Paper Company Limited sulphite mill.

KENORA

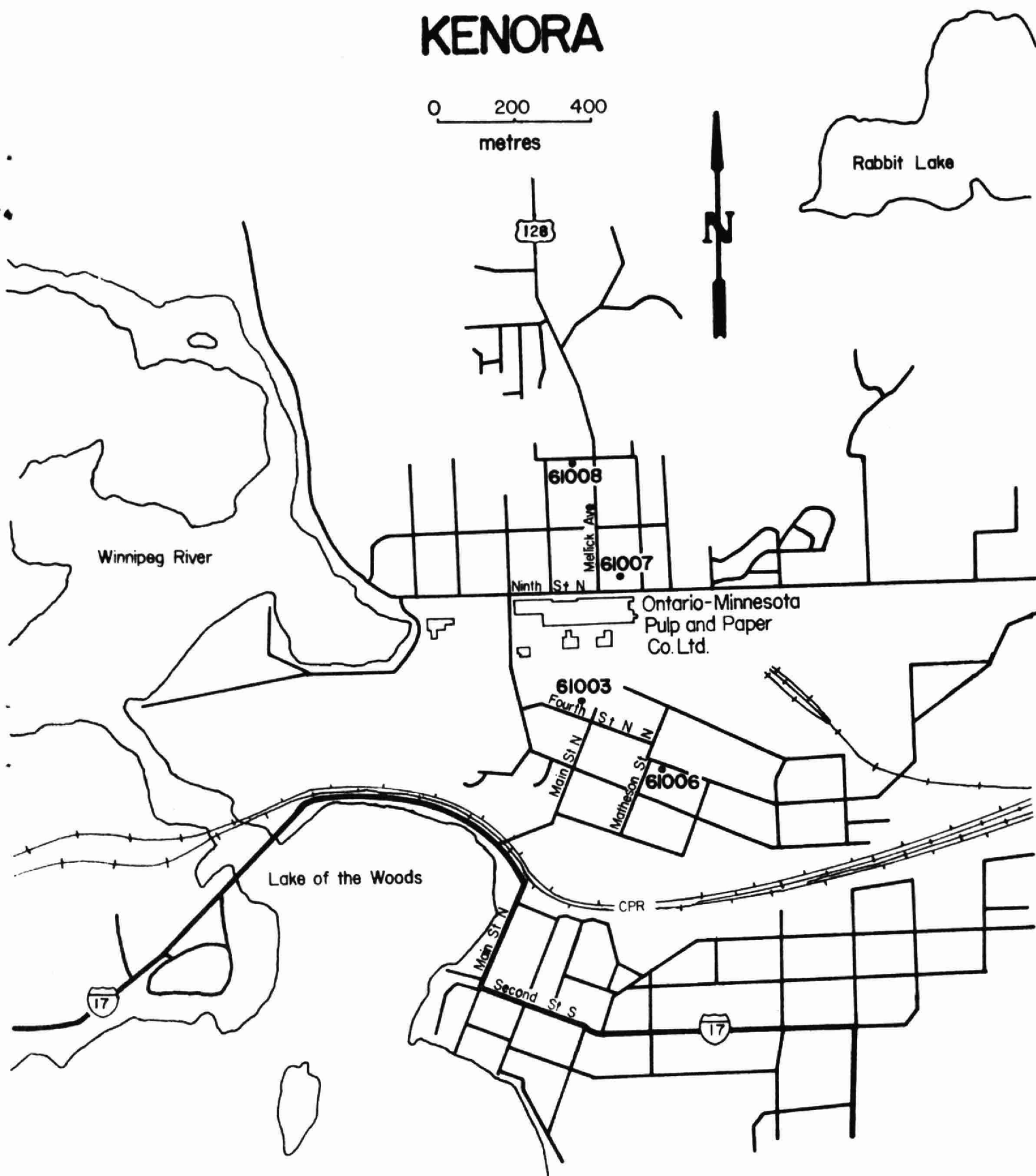


Figure 1. Air monitoring sites, 1976.

KENORA

0 200 400
metres



Rabbit Lake

Winnipeg River

128

9

24

Ninth St N

Mellick Ave

Ontario-Minnesota
Pulp and Paper
Co. Ltd.

12

Fourth St N

Main St N

Matheson St

10

Lake of the Woods

CPR

17

Main St N

Second St S

17

Figure 2. Average dustfall, 1976. (tons/square mile/ 30 days)

KENORA

0 200 400
metres



Rabbit Lake

Winnipeg River

128

0.20

Mellick Ave

0.22

Ninth St N

Ontario-Minnesota
Pulp and Paper
Co. Ltd.

0.22

Fourth St N

Main St N

Matheson St

0.17

Lake of the Woods

CPR

17

Main St N

Second St S

17

Figure 3. Average sulphation, 1976. ($\text{mg SO}_3 / 100 \text{ cm}^2 / \text{day}$)

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